schaevitz

The Name in Transducer Technology

ATA-101 ANALOG TRANSDUCER AMPLIFIER

AND

ATC-101 ANALOG TRANSDUCER CONTROLLER

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ANALOG TRANSDUCER AMPLIFIER

MODEL ATA-101

AND

ANALOG TRANSDUCER CONTROLLER

MODEL ATC-101

INSTRUCTION MANUAL

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DESCRIPTION

GENERAL

The Schaevitz ATA-101 Analog Transducer Amplifier and ATC-101 Analog Transducer Controller are advanced instruments designed for the excitation, amplification and demodulation of AC-operated LVDT-type transducers. These units are fully self-contained, so that connecting an LVDT-type transducer, an indicator, and the AC power line results in a complete measuring system. Physical variables such as displacement, position, weight, force, or pressure can be read out on an external display.

The ATA-101 and ATC-101 are lightweight, portable instruments which feature time-proven carrier amplifiers and synchronous demodulator circuits for accurate tracking of the LVDT output, multi-stage filters to eliminate noise without sacrificing response, and 0-10 VDC outputs to drive oscilloscopes, recorders, and other peripheral devices.

The ATC-101, in addition to all of the above features, has two limit set points for alarm and/or control purposes.

PHYSICAL CONSTRUCTION

The Model ATA-101 Analog Transducer Amplifier and Model ATC-101 Analog Transducer Controller consist of a printed circuit board installed in a 4-inch (102 mm) wide, 10-inch (254 mm) long, and 1.4-inch (36 mm) high aluminum housing. The Amplifier/Demodulator board contains the oscillator, amplifiers, demodulator, and filters. In addition, the Model ATC-101 Analog Transducer Controller also has a Limit Board located to the front of and above the Amplifier/Demodulator board. Front panel controls are mounted on the two printed circuit boards and are operated through openings in the front panel.

CONTROLS, ADJUSTMENTS AND INDICATORS

FRONT PANEL

The basic front panel controls for the Model ATA-101 and ATC-101 are the power switch and three screwdriver adjustments: pha$e, span, and zero. Also included on the Model ATC-101 are the limit set switch, two out-of-limit indicators, an in-limit indicator and two screwdriver adjustments for setting the limits. The functions of these controls are:

Power Switch - Turns the AC power on or off.

Phase Control - Screwdriver adjustment which compensates for transducer or cable phase shift and optimizes the demodulator.

Span Control - Screwdriver gain adjustment to set the full scale analog, output to the desired level.

Zero Control - Screwdriver adjustment to set the electrical zero or zero offset.

The following controls apply to the ATC-101 only:

Momentary contact switch which in OUT_1 position causes the signal/setpoint output to read out #1 set point, and in the OUT_2 position, causes the signal/setpoint output to read out #2 set point. In the normal or center position, the signal/setpoint output reads the measurement.

Set-Out 1 - Screwdriver adjustment to set #1 limit.

Set-Out 2 - Screwdriver adjustment to set #2 limit.

Out & In Indicators - Red LEDs (OUT_1 and OUT_2) illuminate when the respective set point is exceeded. Green LED (IN) illuminates when neither set point is reached.

INTERNAL CONTROLS AND ADJUSTMENTS

The following controls and adjustments are internal to the unit. The unit's top cover must be removed to access them. Also, the Limit board (ATC-101 only) must be removed to gain access to the two Gain Select plug-in links and the Frequency Plug-In module.

The following controls and adjustments are located on the Amplifier/Demodulator board:

Gain Select 1 - This is a plug-in link which determines the gain of the first AC amplifier. If the shorting link is plugged into the front two posts the gain of the first stage is 1.21. With the shorting link plugged into the rear two posts, the gain is 4.74.

Gain Select 2- This is a plug-in link which determines the gain of the second AC amplifier. If the shorting link is plugged into the front two posts, the gain of the second stage is 4.17. With the shorting link plugged into the rear two posts, the gain is 11.0.

Frequency Plug-In - This is 0.85 inch (22 mm) by 0.40 inch (10 mm) dual in-line plug-in module that determines the excitation (oscillator) frequency and the output filter cutoff frequency. The units are normally supplied with a 2.5 kHz/250 Hz module installed. This module selects an excitation frequency of 2500 Hz and a -3 dB output signal frequency response of 250 Hz. A 10 kHz/1 kHz module is also supplied, but not installed.

DIP Switch 1- This is a dual in-line switch with eight (8) sections. These 8 switches control the excitation regulation mode (constant voltage or constant current), zero suppression range (30% or 100%), and the coarse phase adjustments.

The first three switches (Sl-1) , Sl-2, and Sl-3) control whether the primary excitation drive is constant voltage or constant current.

	Sl-1	Sl-2	Sl-3
Constant Voltage (1 to 5 V)	OFF	ON	ON
Constant Current (1 to 5 mA)	ON	OFF	OFF
Constant Current (5 to 25 mA)	ON	ON	OFF

Switch Sl-4 selects either 30% or 100% zero suppression. It is positioned at OFF for ±30% suppression and ON for ±100% suppression.

Switches Sl-5, Sl-6, Sl-7 and Sl-8 are used in conjunction with the front panel Phase control.

Osc Ref Adj* - The oscillator reference adjustment sets the reference voltage in the oscillator section. It is normally adjusted for 12.0 VDC across capacitor C13. Note: This is a factory adjustment and does not need readjustment unless component replacements are made.

Osc Amp Adj - The oscillator amplitude adjustment sets the amplitude of the excitation drive. In the constant voltage mode of regulation its range is from 1 to5Vrms. For constant current, the adjustment range is either 1 to 5 mA or 5 to 25 mA, as selected by Sl-1, Sl-2, and Sl-3.

Freq Adj* - The frequency adjustment sets the oscillator frequency to the desired value. It has been factory set to 2500 Hz. Note: This is a factory adjustment and does not need readjustment unless the Frequency Plug-In Module is changed.

* - Factory Adjustment

SWITCH	Constant Voltage	Constant Current 1-5mA	Constant Current 5-25mA
1	OFF	ON	ON
2	ON	OFF	ON
3	ON	OFF	OFF
4	OFF-30%	ON-100%	ZERO
5	More Plus or CCW		
6	Usual Phase Range		
7	More Minus or CW		
8	NOT USED		

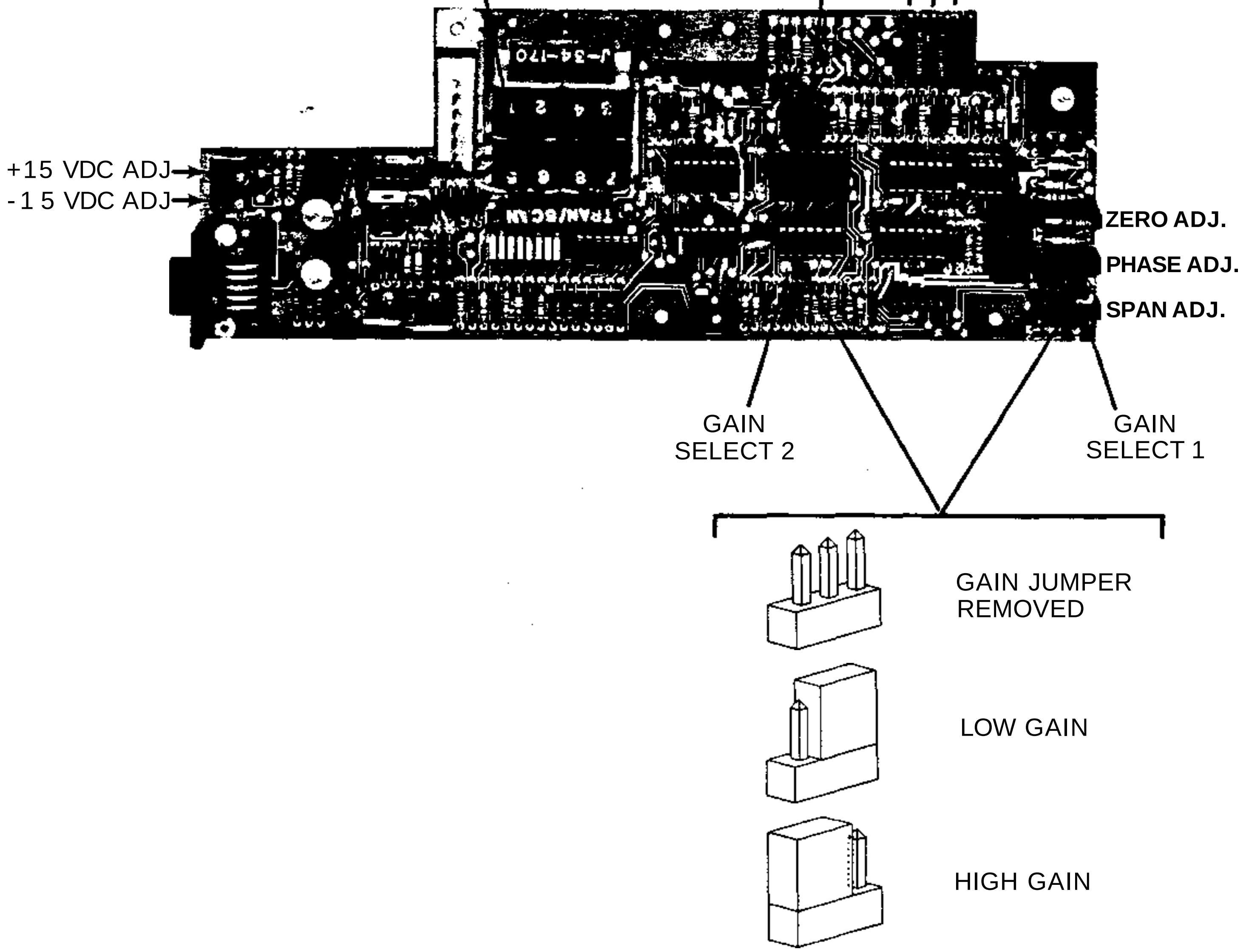


FIG. 1
AMPLIFIER/DEMODULATOR BOARD CONTROLS AND ADJUSTMENTS

+15 VDC Adj* - This control sets the positive supply voltage to the correct level. It has been set to +15.0 VDC at the factory.

-15 VDC Adj* - This control sets the negative supply voltage to the correct level. It has been set to -15.0 VDC at the factory.

* - Factory Adjustment

The following controls and adjustments are located on the Limit board (ATC-101 only):

Hysteresis l Adj - This control adjusts the amount of hysteresis for Limit 1.

Hysteresis 2 Adj - This control adjusts the amount of hysteresis for Limit 2.

DIP Switch - This is a dual in-line switch with eight (8) sections. These 8 switches select whether each limit is a high or low set point and also whether the hysteresis is positive, negative, or balanced.

Type	Switches / Hysteresis	LIMIT 1			LIMIT 2		
		4	5	6	1	2	3
LOW	NONE	OFF	OFF	OFF	OFF	OFF	OFF
LOW	POSITIVE	ON	OFF	OFF	ON	OFF	OFF
LOW	NEGATIVE	OFF	ON	OFF	OFF	ON	OFF
LOW	BALANCED	ON	ON	OFF	ON	ON	OFF
HIGH	NONE	OFF	OFF	ON	OFF	OFF	ON
HIGH	NEGATIVE	ON	OFF	on	ON	OFF	ON
HIGH	POSITIVE	OFF	ON	ON	OFF	ON	ON
HIGH	BALANCED	ON	ON	ON	ON	ON	ON

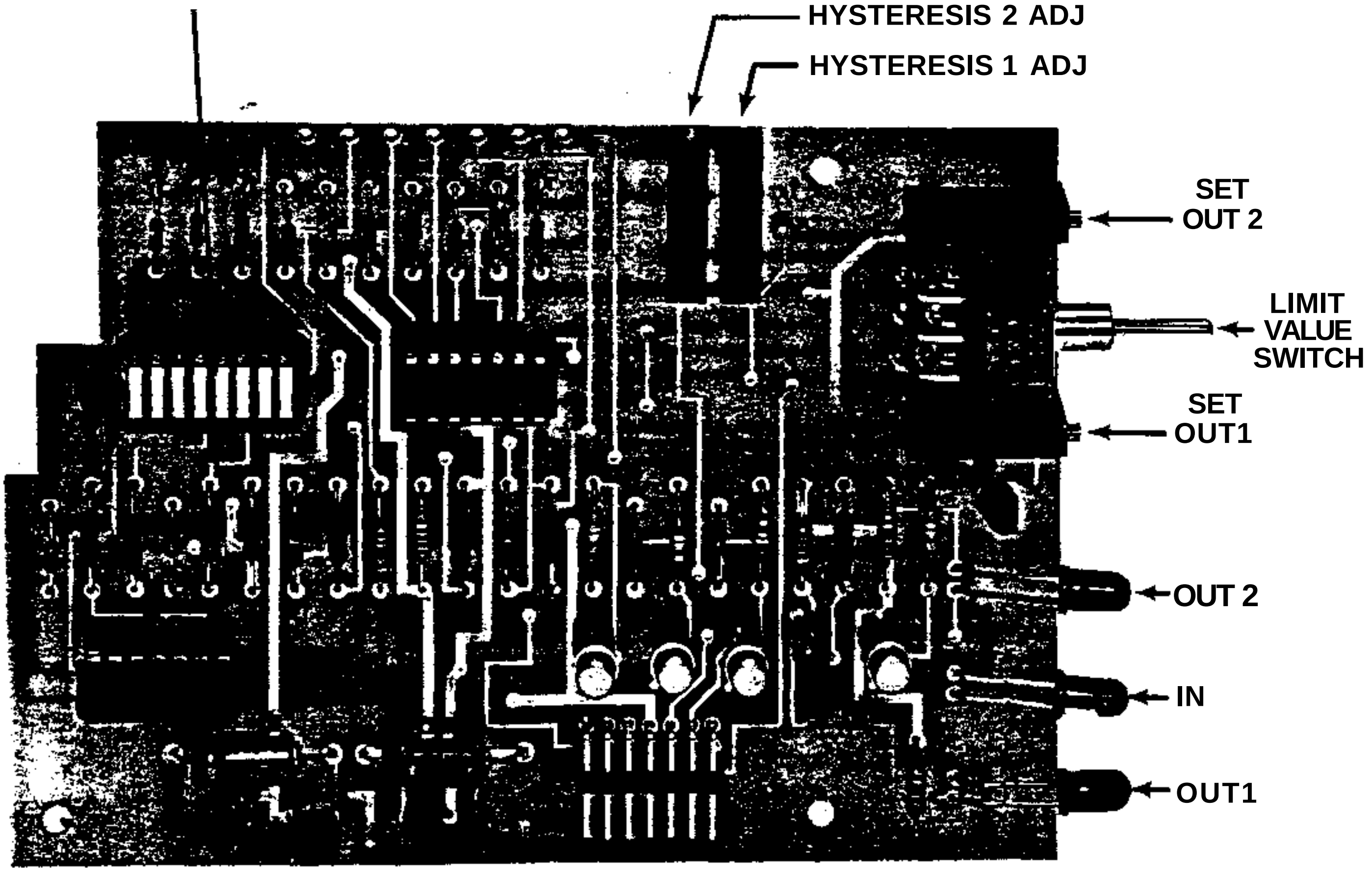


FIG. 2
LIMIT BOARD CONTROLS AND ADJUSTMENTS

ATA-101 AND ATC-101 SPECIFICATIONS

TRANSDUCER EXCITATION

Voltage: 3.5 V rms nominal, constant voltage sine wave (internally adjustable from 1 to 5 V rms)

Output Loading: 0 to 25 mA rms

Internally switchable to constant current; Two ranges; 1 to 5 mA or 5 to 25 mA

Frequency: 2.5 kHz (User-modifiable to 10 kHz by plug-in module)

ANALOG OUTPUT

Voltage: ±10 V DC max

Current: 0 to 10mA max

Output Impedance: Less than 2 ohms

Ripple and Noise: Less than 3 mVrms with standard filter

Frequency Response (-3 dB): 250 Hz, nominal; 1000 Hz, nominal, when 10 kHz excitation frequency selected (Optional 10 Hz responses available)

SIGNAL CONDITIONER CEARACTERISTICS

Sensitivity:

Front Panel Adjustable: 9 to 1 range

500 mV rms produces F.S. out with Front Panel control at max. gain; Internal plug-in jumper increases gain by 2.5, 4, or 10

Internal Plug-In Jumper	Sensitivity
X1	500 mV rms to 4.5 V rms
X2.5	200 mV rms to 1.8 V rms
X4	125 mV rms to 1.125Vrms
Both (X10)	50 mV rms to 0.45 V rms

Line Voltage Regulation: ±10% line voltage change produces no change in output

Input Impedance: 100 Kilohms

Zero Suppression: ±30% of Full Scale (internally switchable to ±100% FSO)

Phase Shift:

120° front panel adjustable

120° additional by internal adjustment

Non-Linearity and Hysteresis: Less than ±0.05% of Full Scale

GENERAL

Stability: Better than ±0.05% of F.S. after 30 mins. warm-up

Temperature Coefficient of Sensitivity: Less than +0.02% of full scale output/°F (±0.036% FSO/°C)

Operating Temperature Range: 30°F to 130°F (0°C to 55°C)

Power Requirements: 115 V AC ±10%, 50-400 Hz (Optional: 220 V AC ±10%, 50-400 Hz)

LIMITS (ATC-101 ONLY)

Set Points: Two analog set points (front panel adjustable), each selectable as high or low

Limit Status: Indicated by red and green front panel LED lights

Set Point Range: ±100% of Full Scale output

Set Point Repeatability: ±0.01% of Full Scale output

Set Point Hysteresis: Internally adjustable

0 to 10% of Full Scale Output: Can be set on either side or both sides of limit

Limit Outputs: Open collector power transistor; TTL-compatible; Capable of handling 40 V DC at 100 mA

REAR

Power: Receptacle with grounding pin (removable line cord and plug supplied)

Input: 9-Pin Series "D" Subminiature Connector, Size E, Socket Contacts

Output: 15-Pin Series "D" Subminiature Connector, Size A, Socket Contacts

Fuse: 1 Amp, 250 V Fast-Acting; 5X20-MM Miniature Fuse

ATA-101: 1.75 lb. (.80 Kg)   ATC-101: 1.75 lb. (.80 Kg)

DIMENSIONS

Overall case without feet or handle: 1.4 inches H X 4 inches W X 10 inches D (36 mm X 102 mm X 254 mm)

CONNECTIONS

INPUT CONNECTIONS

The transducer input for the Model ATA-101 or Model ATC-101 is a nine (9) pin subminiature Series "D" connector located on the rear panel. The instrument is designed for use with 4-, 5-, or 6-lead LVDTs and LVDT-type transducers; however best performance is realized with as few leads as possible in the interconnecting cable. With a 6-wire LVDT, it is best to eliminate two wires in the cable by connecting the secondaries in series opposing mode at the LVDT. Only four (4) wires need be connected between the LVDT and the instrument.

Figure 3 (Input Transducer Connections) shows the proper connections for various types of Schaevitz LVDTs. Connections are shown for LVDTs with lead wires and for LVDTs with connectors, both with and without an extension cable. Two different types of cable are shown.

Secondary leads over a few feet long should be shielded, since they may be sensitive to noise pickup. The shield should be connected to pin 9 on the input connector on the rear panel of the unit. Primary leads are not nearlv as sensitive as the secondary leads and are not ordinarily shielded. A cable, such as Belden 8786, with four (4) jointly shielded conductors and two (2) unshielded conductors is recommended. The independent pair of unshielded wires is used for primary connections and two of the four jointly shielded wires are used for secondary connections.

However, if the LVDT is located in an extremely noisy environment, the primary leads should be shielded separately from the secondary leads. In any case, it is undesirable to have primary and secondary leads within the same shield, as there is apt to be detrimental coupling between them. In this case, a cable, such as Belden 8723, with two twisted shielded pairs must be used.

If more than one LVDT is to be used, both primary and secondary leads must be separately shielded and special attention given to cable dress to prevent heterodyning as a result of unwanted circuit coupling. If heterodyning problems occur and they cannot be eliminated by shielding and/or physical separation of cables, then the carrier signals must be synchronized. See the section on Master/Slave (Synchronized Operation) Wiring for further instructions. At excitation frequencies up to 2.5 kHz, many types of AC-LVDTs can be operated with cables up to 350 feet long. In some systems using special techniques, LVDTs have been operated with much longer cables.

NOTE: The maximum usable cable length is transducer dependent and varies with LVDT type and nominal linear range.

OUTPUT CONNECTIONS

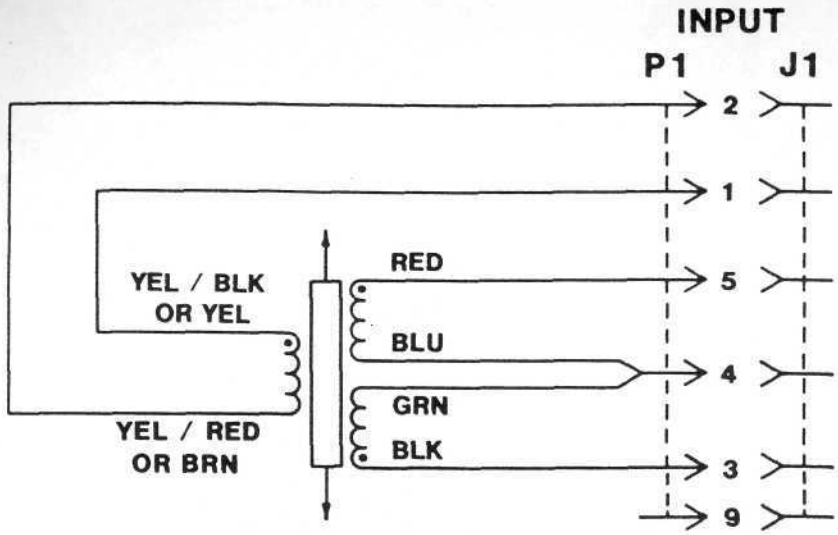
The output for the Model ATA-101 or Model ATC-101 is a fifteen (15) pin subminiature Series "D" connector located on the rear panel.

Analog Output:

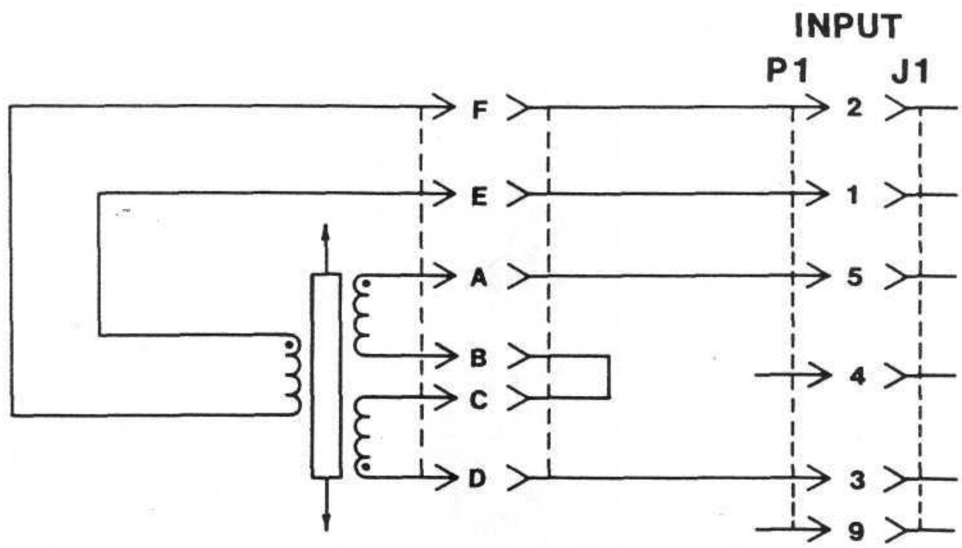
The analog output is available on pin 1. Signal common is pin 2 and the shield is pin 3. Since the analog output is a low impedance, high level (0 to ±10 VDC) signal, the shield will not normally be needed.

Master/Slave (Synchronized Operation) Wiring:

To synchronize the carrier frequencies of two or more instruments, pin 14 of one instrument (the MASTER) must be connected to pin 13 of all the other instruments (the SLAVES). Digital common, pin 15, of all involved instruments must also be connected together.



INPUT CONNECTIONS — LVDT WITH LEADS



INPUT CONNECTIONS — LVDT WITH CONNECTOR

Connect to INPUT JI / Transducer Series	Pin 1	Pin 2	Pin 5	Pin 3	** Pin 4	Pin 9	Not Used
LBB Gage Head	red	blue	green	white	yellow	shield	
all others							
Color-coded	yel/blk or yel	yel/red or brn	red	blk	blu & grn		
Letter-coded	E	F	A	D	B & C	H*	G*
Number-coded	1	2	6	3	4 & 5		

*These will not exist on some units.

**Blue & green, B & C, or 4 & 5 must be connected to each other, but need not be connected to Pin 4 for proper operation. Pin 4 has no connections inside the instrument and is provided only as a convenient point at which to connect the center tap wires together.

When using a cable, it is preferable to connect the center tap wires at the transducer and not run them to the instrument.

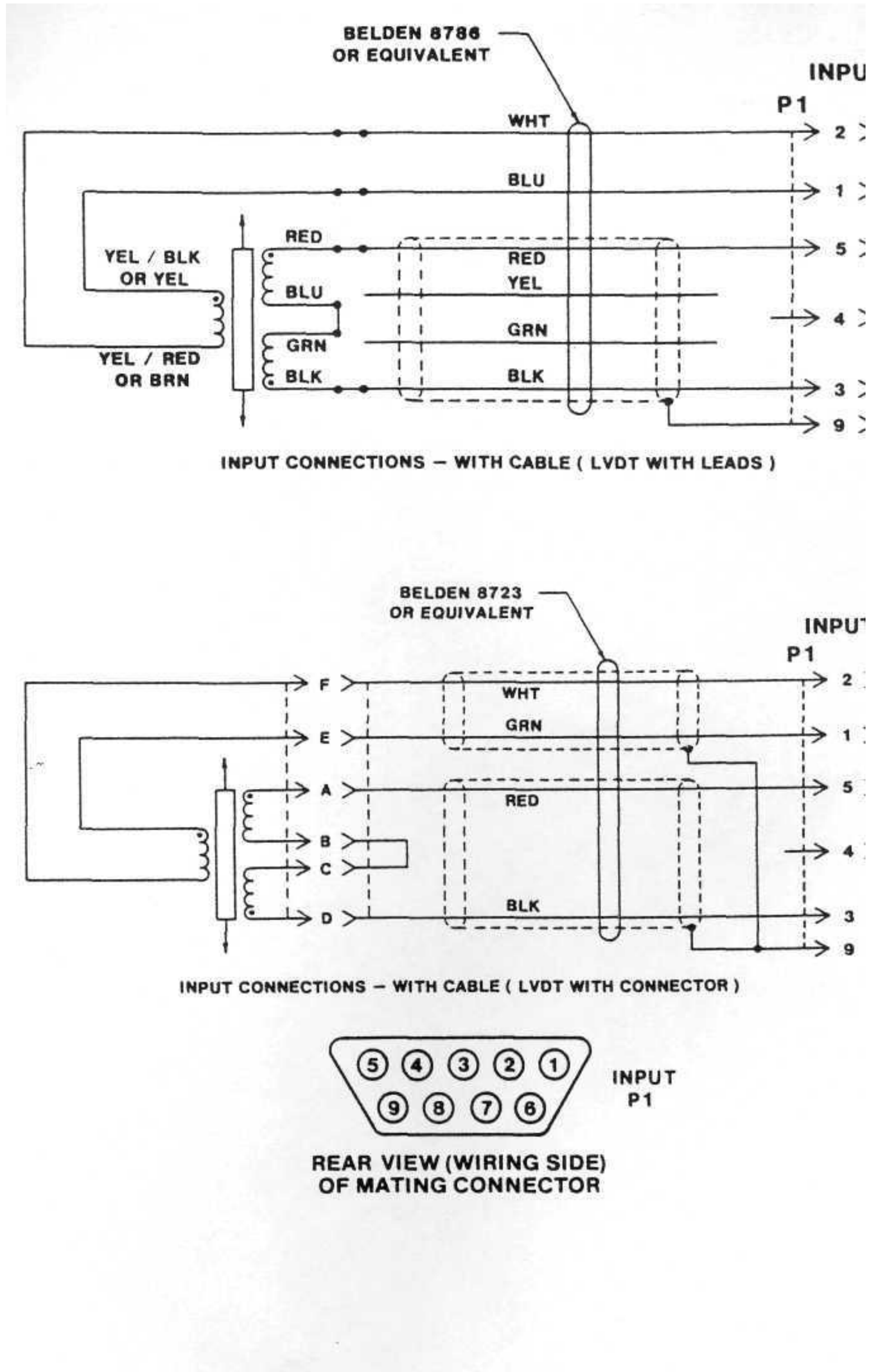


FIG. 3
INPUT TRANSDUCER CONNECTIONS

Signal/Setpoint Output (ATC-101 only):

Normally the analog output (same as on pin 1) is available on the Signal/Setpoint Output (pin 4); however, when the LIMIT-VALUE Switch on the front panel is placed in either the OUT_1 or OUT_2 position, then the value of that particular setpoint is switched to the Signal/Setpoint Output (pin 4). This output should be used rather than the Analog Output (pin 1) whenever the same readout device will be used to read both the analog output signal and the value of the limit setpoint.

Limit Outputs (ATC-101 only):

The two limit outputs are on pin 10 (Limit 1) and pin 9 (Limit 2). Power common is on pin 11. The outputs are open collector transistors capable of switching 100 mA maximum and up to 40 VDC. The output transistors are normally off and are turned on when the limit or setpoint is exceeded.

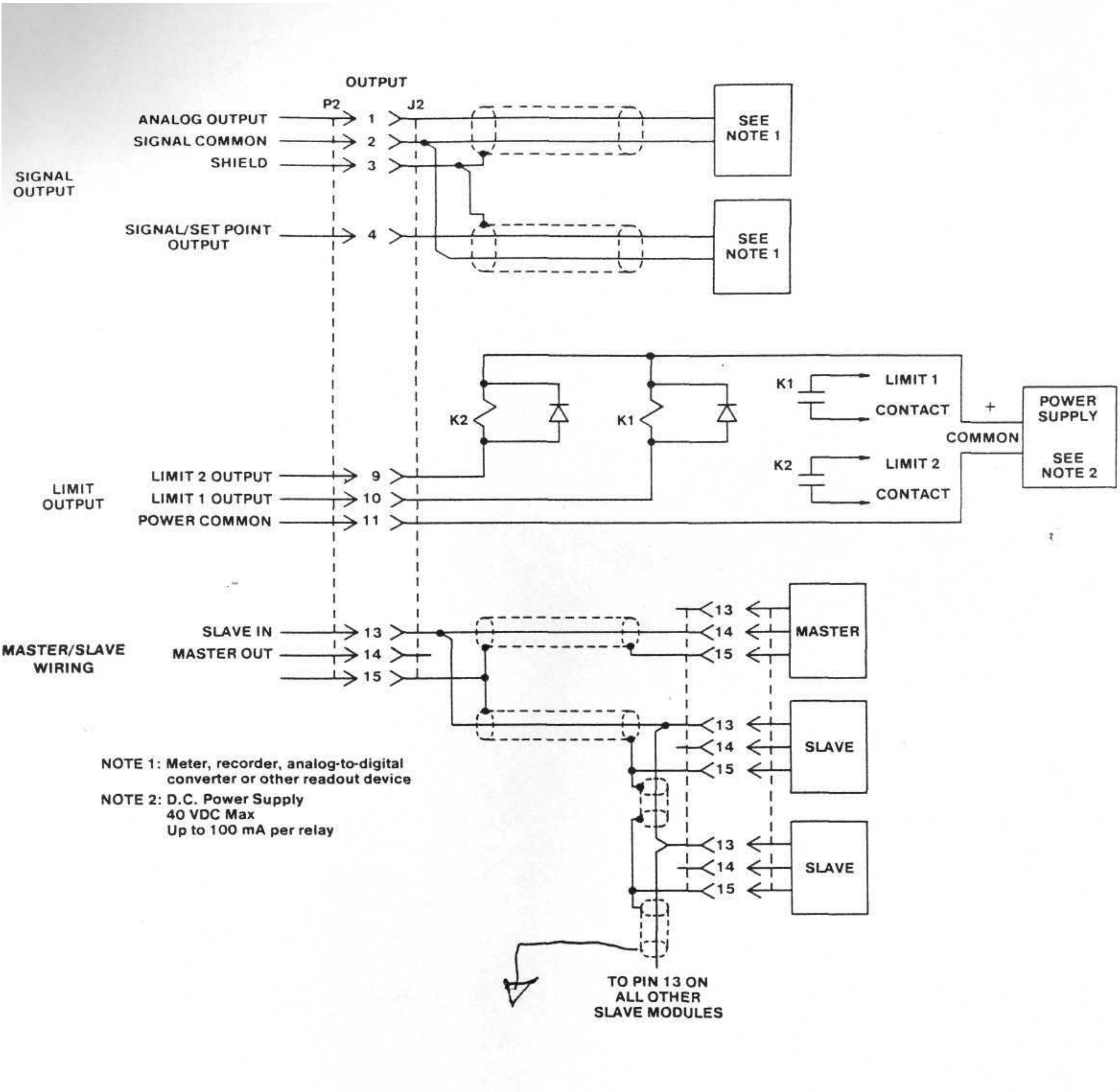


FIG. 4
OUTPUT CONNECTIONS

OPERATION

PRELIMINARY ADJUSTMENTS

Transducer Excitation:

The transducer excitation, as shipped from the factory, is set for constant voltage, 3.5 V rms, at 2500 Hz. This is the correct setting for the majority of LVDTs.

If some other excitation voltage is needed, the excitation amplitude may be adjusted from 1 to 5 V rms with the Osc Amp Adj control. If an excitation frequency other than 2500 Hz is needed, the Frequency Plug-In Module should be changed. (Note: A 10 kHz Frequency Plug-In Module is supplied with each instrument.)

If it is determined that constant current excitation is needed, then switches 1, 2, and 3 of the DIP switch must be changed. Switch 1 should be turned ON and Switch 3 should be turned OFF. Switch 2 should be OFF for 1 to 5 mA range and ON for 5 to 25 mA. The Osc Amp Adj still controls the excitation amplitude.

Gain Select:

Both Gain Select plug-in links are factory set to the low gain setting. This permits a transducer input (full scale) from 0.5 to 4.5 V rms, which will be adequate for the majority of LVDTs. If more gain is needed, one or both of the Gain Select links may be moved to their high gain position. The full scale transducer output may be calculated by multiplying the transducer's sensitivity (in mV Out/Volt In Per .001 Inch) by the primary excitation voltage and by the full scale displacement in 0.001 inch. The transducer's sensitivity may be found by looking it up in the catalog or by determining it from information given on the data sheet enclosed with the transducer.

Examples:

(1) Assume a Schaevitz Model 050 HR LVDT is being used to measure a 0.050 inch. The catalog shows a sensitivity of 6.3 mV/V/.OOl inch. If the primary excitation has been factory set to 3.5 V rms and the full scale displacement is 50 thousandths of an inch, then

$$\text{Full Scale Transducer Output} = (6.3)(3.5)50$$
$$= 1102.5 \text{ mV}$$
$$= 1.1025 \text{ V}$$

The standard (XI) gain range, with both Gain Select links in the low position, is adequate for this application and no changes need be made.

(2) Assume a Schaevitz Model LBB-375-TA-060 is being used to measure 0.020 inch. The data sheet indicates that the full scale output for .060 inch is 900 mV rms, and also that the LBB was tested at 6 V rms primary voltaqe. *

Transducer Data = 900mV/6Vin/.060 inch

Dividing out, Transducer Sens = 2.5 mV/V/,001 inch

Assuming the factory set excitation of 3.5 V rms, and using the sensitivity derived above, the Transducer Output Under

$$\text{Operating Conditions} = (2.5)(3.5)(20)$$
$$= 175 \text{ mV}$$

The standard (XI) range will not provide enough gain. Any of the three higher standard ranges could be used, but it is desirable to use XI or X4 as much as possible. Therefore, move Gain Select 1 link to its high gain position and use the X4 gain position for this example. Refer to Figure 1, on page 6 for Gain Select links.

Gain Select 1 Position	Gain Select 2 Position	Gain Range	Sensitivity Range
LOW	LOW	Xi	500mVrms to 4.5V rms
LOW	HIGH	X2.S	200 mV rms to 1.8 V rma
HIGH	LOW	X4	125 mV rms to 1.125 Vrms
HIGH	HIGH	X10	50 mV ran to 0.45 Vrms

CALIBRATION

After installation and connection of the transducer and output display devices are complete, connect the power cord to the proper AC power receptacle, being certain that the line voltage is compatible with the power requirements of the ATA-101 or ATC-101.

1. Turn the power switch ON and allow instrument to warm-up for 30 minutes. Turn on the display or readout, if necessary.

2. Disconnect the transducer input connector and turn the Zero adjustment for an indicated output of zero volts DC.

3. Reconnect the transducer input connector and move the LVDT core so that the output is as close to zero volts as possible. This is the null position of the transducer from which the plus and minus displacements are usually measured.

   NOTE: If this adjustment is mechanically difficult or impractical, approximate the correct position as closely as possible and then turn the Zero control to obtain a zero reading.

4. Move the LVDT core from the null position to approximately half way to the transducer's plus full scale position. Turn the Span adjustment for an output of 5 to 6 VDC.

   NOTE: Plus full scale for an LVDT is the maximum rated displacement of the core into the LVDT from null toward the lead exit or connector end of the LVDT. This should result in a positive output from the ATA-101. To reverse the output polarity for this direction, interchange the secondary connections on terminals 3 and 5 of J_1.

5. Now adjust the Phase control to obtain a maximum meter reading. Use the Span control, if necessary, to keep the reading between 5 VDC and 10 VDC.

The position of the Phase control which yields maximum output can be identified because turning the Phase control in either direction beyond it will cause the displayed reading to decrease.

If such a maximum reading is not obtainable within the range of the front-panel Phase adjustment, the internal DIP switch must be reset to change the range of phase adjustment. If the reading goes to a maximum and does not decrease but levels off as the Phase control is turned continuously in one direction, the Phase control is at the end of its travel. A slight clicking may be heard or felt. On the internal DIP switch, turn switch #6 to OFF. Then, if the Phase control is at the CCW (counterclockwise) end, turn switch #5 ON. If the Phase control is at the CW (clockwise) end then turn switch #7 ON. Switch #8 is not normally used. One and only one of switches #5, #6, #7,or #8 must be on.

6. Displace the LVDT core back to the precise null position. If necessary adjust the Zero control until the output reads zero volts.

7. Displace the core, again, from the null position to exactly plus full scale displacement. Turn the Span control until the output reads the desired full scale voltage, usually 10 VDC.

If the required full scale reading cannot be obtained by adjusting the Span control, the gain of the signal conditioner can be reset by changing the internal jumpers, Gain Select 1 and Gain Select 2. See Figure 1, page 6 for Gain Select links.

8. Repeat steps 6 and 7, if necessary.

CALIBRATION WITH 100% ZERO SUPPRESSION

The previous CALIBRATION procedure will calibrate the instrument for an output of ±10 VDC for - full scale to + full scale displacement. For some applications, it is desirable to calibrate the instrument to go from zero to +10 VDC for - full scale to + full scale displacement.

1-6. Follow steps 1 through 6 under CALIBRATION. Then proceed as follows:

7. Displace the core from the null position to exactly plus full scale displacement. Turn the Span control until the output reads 5 VDC.

If the required reading cannot be obtained by adjusting the Span control, the gain of the signal conditioner can be reset by changing the internal jumpers, Gain Select l and Gain Select 2.

8. Displace the transducer core to the negative full scale core position. The output should read -5.0 VDC. Adjust the Zero control until the output reads zero volts.

9. Move the core back to the plus full scale position. The output should now read +10 VDC. Adjust with the Span control, if necessary.

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SETPOINT (LIMITS) CALIBRATION (ATC-101 ONLY)

Definitions:

A high limit is defined as a setpoint or limit in which the output or alarm turns on when the signal goes more positive than the set limit. A low limit is a limit where the output or alarm turns on when the signal goes more negative than the set limit.

Hysteresis is the difference between the level at which the alarm turns on and the level at which it goes off. If the on and off levels are centered on either side of the set limit, then the hysteresis is balanced. Positive hysteresis means there is no hysteresis approaching the limit or going into the alarm condition, but there is hysteresis coming back into the limits. The reverse is true for negative hysteresis. In this case, hysteresis occurs going into the alarm condition but not coming back into the limit.

Initial Setup (Internal Adjustments):

After determining the type of limit (high or low) and the type of hysteresis (positive, negative, or balanced), if any, that fits the application, set switches #4, #5, and #6 on the Limit board for the desired combination, as shown in the table in Figure 2, page 9. If a second limit is desired, set switches #1, #2, and #3 for Limit 2.

If some type of hysteresis is selected, then the amount of hysteresis must be set. To determine the amount of hysteresis, first set the voltage close to the limit setpoint by adjusting the input signal. Then carefully change the signal until the setpoint is exceeded and the status indicators go from green to red. Note the exact voltage at which the status indicators switch from green to red. Now change the signal in the other direction until it is back in limits. Again note the exact value at which the status indicators switch. The difference between the two values is the amount of hysteresis. The amount of hysteresis may be adjusted with the Hysteresis 1 Adj or the Hysteresis 2 Adj controls located on the Limit board.

Limit Adjustment:

The ATC-101 must be calibrated and setup as described in pages 18 through 23 before limit adjustments can be made. The procedure for the limit adjustments is as follows:

1. To adjust Limit 1, hold the LIMIT/VALUE momentary contact switch to the left in the Set Out_1 position, and adjust the Set Out_1 screwdriver control until the desired setpoint is obtained by the output voltage.

2. To adjust Limit 2, follow the procedure given in Step 1 with the LIMIT/VALUE momentary contact switch held to the right in the Set Out_2 position while adjusting the Set Out_2 screwdriver control.

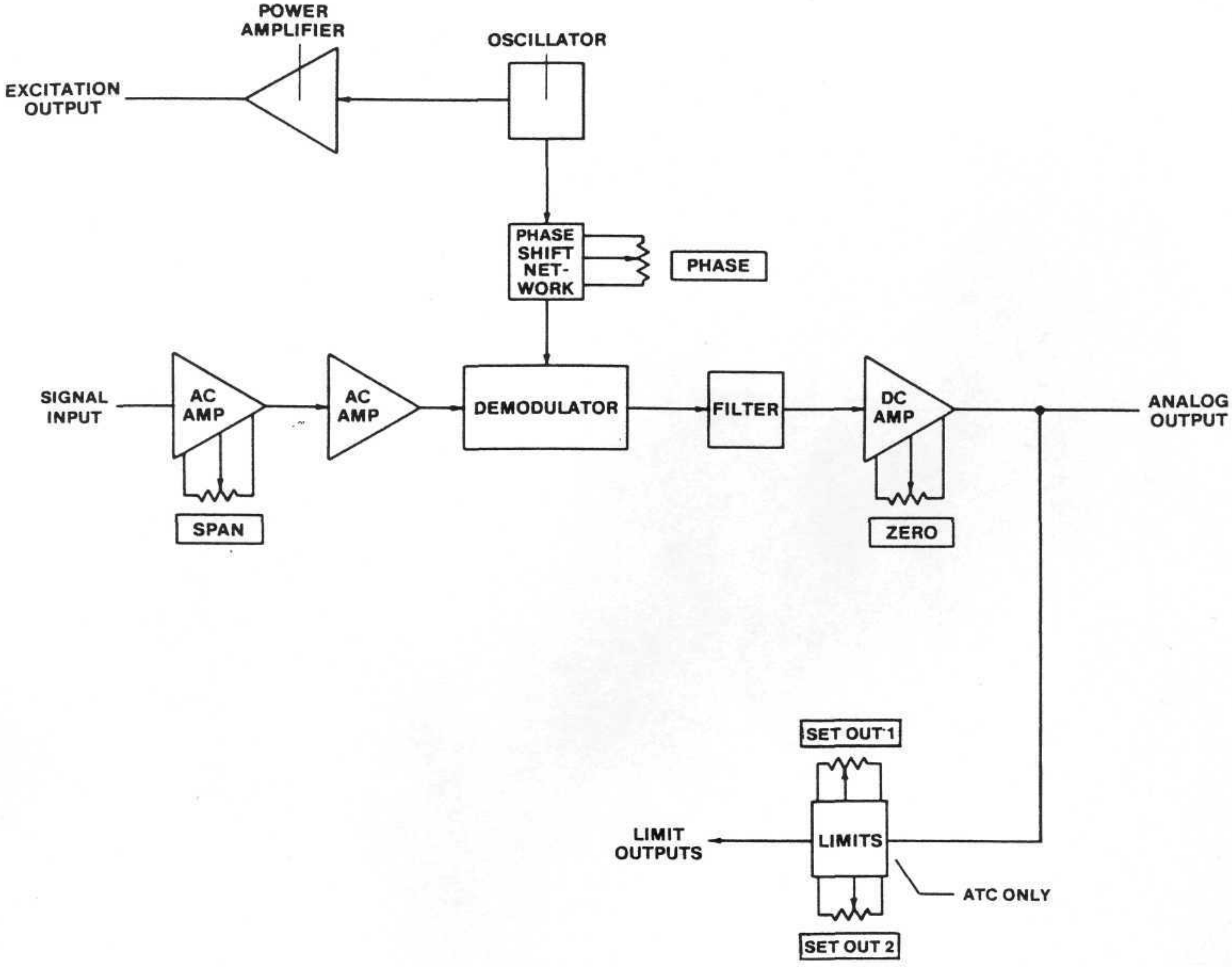


FIG. 5
BLOCK DIAGRAM

THEORY OP OPERATION

AMPLIFIER/DEMODULATOR BOARD

LVDT EXCITATION

The LVDT excitation is a variable amplitude sinewave. Two Schmitt triggers form a squarewave oscillator with a frequency that is sixteen (16) times the excitation frequency. This provides the clock signal to an 8-bit parallel-out serial shift register. The outputs of this shift register are summed through eight resistors to generate a sixteen (16) level staircase waveform. These resistor values are weighted so that the staircase levels are distributed in accordance with a sine function. After passing through a two-pole low pass filter, this waveform becomes a very low distortion sinewave. The amplitude of this sinewave is controlled by a feedback loop consisting of a precision half-wave rectifier and comparator. After being rectified and filtered the signal is compared with a DC reference voltage. The difference between the feedback and reference signal is used to control the bias voltage to the shift resistor and thus control the sinewave amplitude.

A power amplifier is used to provide sufficient excitation current for the LVDT primary. By internal DIP switches, this power amplifier may be programmed for either constant voltage or constant current output.

AC AMPLIFIER

The AC amplifier is composed of two sections, each of which has a low and high gain selectable by internal plug-jumpers. The first section has a gain of either 1.2 or 4.6 depending upon the position of the Gain Select 1 jumper. The second section gain is either 4.2 or 10 according to the Gain Select 2 jumper.

Between these two sections there is a continuously variable Span (gain) adjustment with a ranqe of 11:1. Thus, the AC amplifier produces AC signals of suitable levels for full-scale demodulation at all input amplitudes.

DEMODULATOR

The differential voltage from the two LVDT secondaries represents the core displacement from null. This AC voltage is demodulated to produce a variable DC voltage corresponding to core position or movement. The demodulation process is phase-sensitive in order to produce a DC polarity which indicates the direction of the core displacement from null.

The demodulator is an operational amplifier whose gain is switched from +1 to -1 by two FET switches. Full-wave rectification of the AC signal in the demodulator circuit is produced by alternately turning on these two FET switches by a switching voltage of the same frequency as the transducer excitation signal. The phase of this switching voltage is exactly in-phase or 180° out-of-phase with the AC input signal, to produce a plus or minus DC output signal (full-wave rectified pulses). This circuit operation is known as synchronous demodulation.

The switching voltage required for synchronous demodulation is derived from the LVDT excitation voltage. This signal passes through a phase-shifting stage before turning the FET switches on and off at the carrier frequencv. The two switches are driven 180° out-of-phase.

The phase of the switching voltage is adjustable because of the variation in the phase angle of the secondary voltages produced by different LVDTs in combination with different shielded cables. Normally once a particular LVDT has been hooked up, the Phase adjustment need not be disturbed, because the LVDT has a relatively constant phase angle throughout the linear range of core displacement. There is a total demodulator phase-angle adjustment range of about ±120°.

ANALOG SIGNAL OUTPUT

The demodulator output signal is a series of full-wave pulses at the excitation frequency which pass through a three-pole, low-pass active filter to become a smooth analog signal. The magnitude and polarity of this signal correspond accurately to LVDT core position. The signal amplitude response is 3 dB down at 250 Hz or 1000 Hz depending on the excitation frequency.

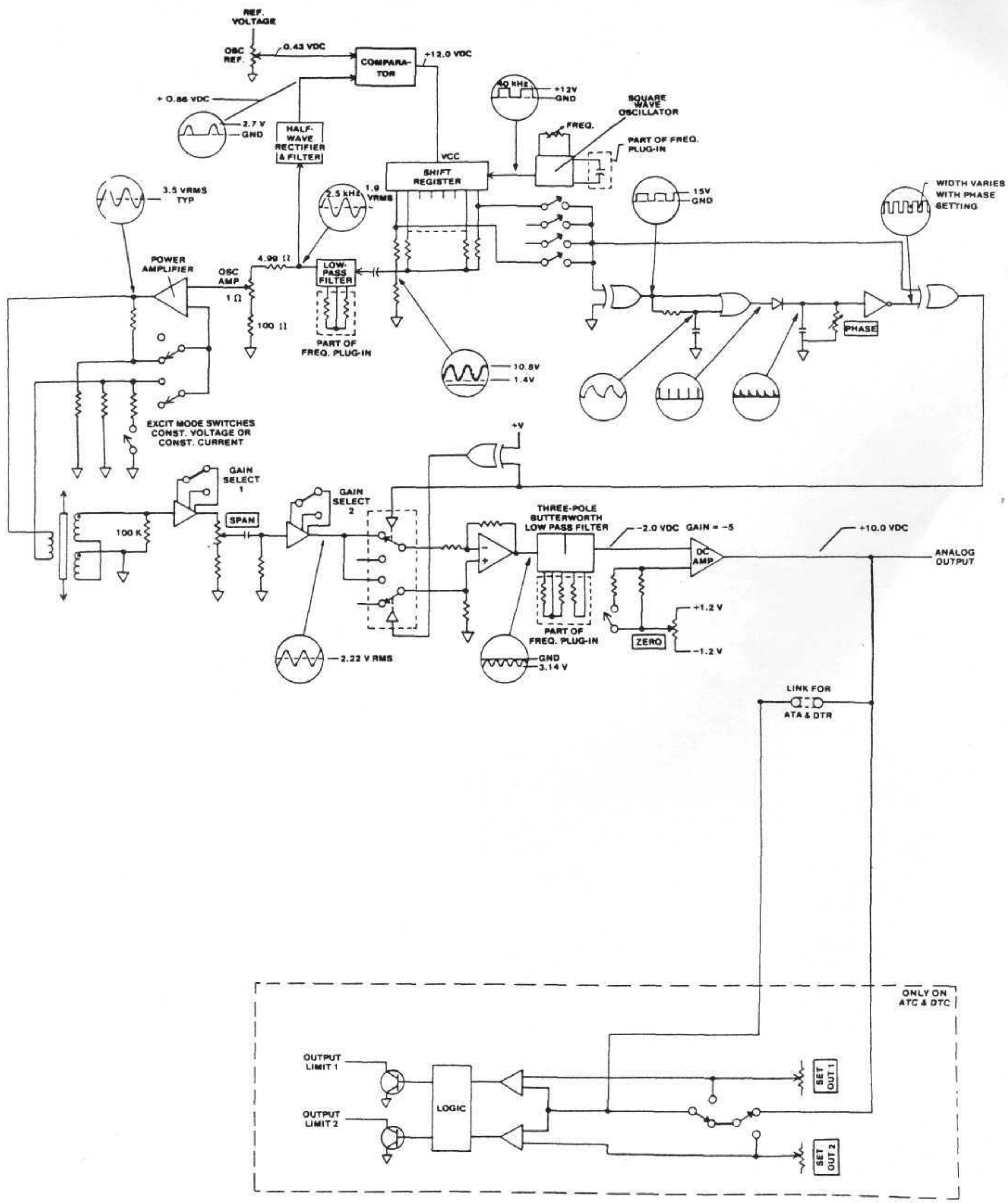
A DC amplifier stage follows the low-pass filter signal. This amplifier is rated for ±10 V maximum output at currents up to +5 milliamperes, terminating at the rear panel output terminals.

LIMIT BOARD (ATC-101 ONLY)

The reference voltage of 2.5 V (±1.25 V) from the LM385Z diode is amplified by U1A or UlB to ±10 V. Its magnitude is controlled by the front panel controls Set-Out 1 and Set-Out 2. This reference voltage is applied to one side of the comparator. The input signal is applied to the other side. When the signal exceeds the reference voltage the output of the comparator goes high.

Current from the constant current diode, CR7 or CR8, flows through potentiometer R22 or R23 to generate a voltage in series with the signal. This voltage is the hysteresis voltage. Its magnitude is set by potentiometers R22 and R23.

The output of the comparators passes through an exclusive OR gate. Switch S1 connected to the input of the OR gate determines whether the limit is low or high. The output of the OR gate then turns on a red LED indicator and output transistor, if the signal input exceeds the limit setpoint.



SIMPLIFIED SCHEMATIC